

REMARKS

This is intended as a full and complete response to the Office Action dated May 31, 2005, having a shortened statutory period for response extended one month to and including September 30, 2005. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1, 5-9, and 11-14 remain pending in the application and are shown above. Claims 2-4, 10, and 15-20 have been canceled by Applicants. Claims 1, 5-9, and 11-14 are rejected. Reconsideration of the rejected claims is requested for reasons presented below.

Applicants have amended claims 1, 5, 7, 9, 11, 12, and 14 to more clearly illustrate the claimed subject matter. Applicants have canceled claims 2-4, 10, and 15-20. Applicants submit that the changes made herein do not introduce new subject matter.

Restriction to one of the following inventions is required under 35 U.S.C. § 121:

- I. Claims 1-9 and 11-14, drawn to a method, classified in class 148, subclass 518.
- II. Claims 10 and 15, drawn to a copper layer, classified in class 148, subclass 518.
- III. Claims 16-18, drawn to an apparatus, classified in class 204, subclass 274.
- IV. Claims 19 and 20, drawn to a computer storage medium, classified in class 703, subclass 1.

Applicants confirm election of Group 1, claims 1, 5-9, and 11-14. Applicants have canceled the non-elected claims to expedite prosecution.

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by *Martin* (U.S. Patent No. 4,786,337) or *Ames, et al.* (U.S. Patent No. 4,904,313). Applicants submit that neither *Martin* nor *Ames, et al.* teaches or suggests rinsing a substrate in a cleaning station of an integrated processing system and then treating the copper layer on the substrate in a gas environment comprising nitrogen (N₂) and hydrogen (H₂) in a chamber of the integrated processing system. Thus, neither *Martin* nor *Ames, et al.*

teaches, shows, or suggests a method for annealing a copper layer, comprising forming the copper layer on a substrate by electroplating in a first chamber of an integrated processing system, rinsing the substrate in a cleaning station of the integrated processing system, and then treating the copper layer in a gas environment in a second chamber of the integrated processing system, wherein the gas environment comprises nitrogen (N₂) and hydrogen (H₂), as recited in amended claim 1. Applicants respectfully request withdrawal of the rejection of claim 1.

Claim 1 and 11 stand rejected under 35 U.S.C. § 102(e) as being anticipated by *Kitazawa, et al.* (U.S. Patent No. 6,178,623) or *Uzoh, et al.* (U.S. Patent No. 6,355,153). Applicants respectfully traverse the rejection.

Kitazawa, et al. describes plating a copper layer on a substrate in a plating bath and then performing a thermal diffusion step in which the substrate is rinsed and treated in an inert gas atmosphere of mainly nitrogen (column 11, lines 10-27). *Kitazawa, et al.* does not teach or suggest rinsing the substrate in a cleaning station of an integrated processing system or treating the copper layer in a gas environment comprising nitrogen and hydrogen in another chamber of the integrated processing system.

Uzoh, et al. describes rinsing a substrate, plating copper on the substrate using a plating bath, and then annealing the substrate at room temperature or in a suitable oven, tube furnace, or vacuum chamber in a nitrogen ambient (column 11, lines 34-47). *Uzoh, et al.* does not teach or suggest that the substrate is rinsed in a cleaning station of an integrated processing system that also contains a chamber in which the copper plating is performed. Furthermore, *Uzoh, et al.* does not teach or suggest treating the substrate in a gas environment comprising nitrogen (N₂) and hydrogen (H₂), wherein the treating is performed in another chamber of the integrated processing system after the substrate is plated and rinsed.

Thus, neither *Kitazawa, et al.* nor *Uzoh, et al.* teaches, shows, or suggests a method for annealing a copper layer, comprising forming the copper layer on a substrate by electroplating in a first chamber of an integrated processing system, rinsing the substrate in a cleaning station of the integrated processing system, and then treating the copper layer in a gas environment in a second chamber of the integrated processing system, wherein the gas environment comprises nitrogen (N₂) and hydrogen

(H₂), as recited in amended claim 1. Applicants respectfully request withdrawal of the rejection of claim 1.

Furthermore, neither *Kitazawa, et al.* nor *Uzoh, et al.* teaches, shows, or suggests a method of annealing a copper layer, comprising forming the copper layer on a substrate by electroplating in a first chamber of an integrated processing system, rinsing the substrate in a cleaning station of the integrated processing system, and then treating the copper layer in a gas environment at a temperature of between about 200 to about 500°C for a time duration of less than about 5 minutes in a second chamber of the integrated processing system, wherein the gas environment comprises nitrogen (N₂) and hydrogen (H₂), as recited in claim 11. Applicants respectfully request withdrawal of the rejection of claim 11.

Claim 1 stands rejected under 35 U.S.C. § 102(e) as being anticipated by *Maeda* (U.S. Patent No. 6,241,869). The Examiner states that *Maeda* discloses electroplating copper followed by treating in a non-oxidative gas such as nitrogen, argon, and/or hydrogen. Applicants respectfully submit that *Maeda* describes a non-oxidative gas atmosphere for pre-treating a substrate and during substrate plating but does not describe treating a copper layer in a gas environment comprising nitrogen (N₂) and hydrogen (H₂) after rinsing the substrate in a cleaning station of an integrated processing system. Thus, *Maeda* does not teach or suggest all of the limitations of claim 1. Applicants respectfully request withdrawal of the rejection of claim 1.

Claims 1, 5-8, and 11-13 stand rejected under 35 U.S.C. § 102(a) as being anticipated by *Simpson, et al.* Applicants note that the effective reference date of *Simpson, et al.* is October 17-22, 1999. Applicants submit that the pending claims have an effective filing date of March 5, 1999, based on priority application Serial No. 09/263,126. Thus, *Simpson, et al.* is not prior art to claims 1, 5-8, and 11-13. Applicants respectfully request withdrawal of the rejection of claims 1, 5-8, and 11-13.

Claims 1, 5-9, and 11-14 stand rejected under 35 U.S.C. § 102(b) as being anticipated by *Sandhu, et al.* *Sandhu, et al.* describes plating copper on a substrate in a plating bath and annealing the substrate in an inert gas oven. Applicants submit that *Sandhu, et al.* does not describe or suggest rinsing the substrate in a cleaning station of an integrated processing system, wherein the substrate is also plated with copper in

one chamber of the integrated processing system and treated in a gas environment comprising nitrogen (N₂) and hydrogen (H₂) in another chamber of the integrated processing system. Thus, *Sandhu, et al.* does not provide or suggest all of the limitations of claims 1 and 11. Applicants respectfully request withdrawal of the rejection of claim 1 and of claims 5-9, which depend thereon. Applicants respectfully request withdrawal of the rejection of claim 11 and of claims 12-14, which depend thereon.

Claims 5-9 and 11-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Maeda*. Applicants submit that claims 5-9 and 11-14 are patentable over *Maeda* for the reasons discussed above with respect to claim 1. Applicants respectfully request withdrawal of the rejection of claims 5-9 and 11-14.

Claims 9 and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Simpson, et al.* Applicants submit that claims 9 and 14 are patentable over *Simpson, et al.* for the reasons discussed above with respect to claims 1 and 11. Applicants respectfully request withdrawal of the rejection of claims 9 and 14.

Claims 1, 5-9, and 11-14 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-39 of co-pending Application No. 10/074,353. Applicants respectfully submit that amended claims 1 and 11 have a separate basis for patentability than claims 1-39 of co-pending Application No. 10/074,353, as claims 1-39 of co-pending Application No. 10/074,353 do not recite a method that includes rinsing a substrate in a cleaning station of an integrated processing system and then treating the copper layer on the substrate in a gas environment in a chamber of the integrated processing system. Applicants respectfully request withdrawal of the provisional rejection of claims 1, 5-9, and 11-14.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

The secondary references made of record are noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, Applicants believe that a detailed discussion of the secondary references is not necessary for a full and complete response to this office action.

Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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